Atty. Docket No. 155695-0112
Express Mail Label No. EL489787542US

UNITED STATES PATENT APPLICATION

FOR

HEART STABILIZER SUPPORT ARM

INVENTORS:

DAN SANCHEZ
EDWARD R. SNOW
KEN GRACE

PREPARED BY:

IRELL & MANELLA LLP
840 Newport Center Drive
Suite 400
Newport Beach, California 92660
(949) 760-0991

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a support arm for a heart stabilizer used during a coronary surgical procedure.

2. Background Information

Coronary artery disease can lead to insufficient blood flow that can cause angina and ischemia. A coronary artery bypass graft (CABG) surgical procedure is sometimes required to correct this condition. In a CABG procedure an incision is made in the artery adjacent to the diseased area. The internal mammary artery of the patient is then severed and attached to the artery at the point of incision.

It is generally difficult to perform a CABG procedure with a beating heart. One solution is to stop the heart and connect the patient to a cardiopulmonary bypass system that supplies oxygen to the brain. Connecting the patient to the cardiopulmonary bypass system increasing the time required to perform the procedure and decreases the

likelihood of success. Additionally, the heart must be successfully resuscitated.

There have been developed procedures to perform "beating heart" CABG procedures that do not require a cardiopulmonary bypass system. A heart stabilizer is typically utilized in a beating heart "CABG" to minimize the movement of the heart at the surgical site. Heart stabilizers typically include an end effector located at the end of an articulate arm. The end effector pushes down on the heart area adjacent to where the surgeon grafts the artery.

Historically CABG procedures are performed in an "open" chest cavity where the sternum is cut open. There have also been developed minimally invasive CABG procedures that are performed with the assistance of a robotic system. Such a robotic system is sold by Computer Motion, Inc. of Goleta, California under the trademark ZEUS and is disclosed in U.S. Patent No. 5,762,458. The ZEUS system can be utilized to perform minimally invasive beating heart CABG procedures. Minimally invasive beating heart CABG procedures require a heart stabilizer that can be inserted

into a patient through a port. The heart stabilizer is typically held by a surgeon's assistant. The assistant may have to hold the stabilizer in position for a relatively long period of time. This may lead to fatigue. It is desirable to provide a mechanism which can support the heart stabilizer so that a surgical aide does not have to hold the stabilizer.

BRIEF SUMMARY OF THE INVENTION

One embodiment of the present invention is a support arm for a heart stabilizer. The support arm may have an arm that is coupled to a table mount and an end effector.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an embodiment of a support arm of the present invention;

Figure 2 is an enlarged view of an end effector of the support arm;

Figure 3 is a perspective view of the support arm coupled to a table and a heart stabilizer coupled to an end effector of the arm.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In general the present invention includes a support arm that can be mounted to a surgical table and support a heart stabilizer. The heart stabilizer can be inserted into a patient and utilized to perform a beating heart coronary artery bypass graft (CABG) procedure. The support arm may be adjustable to allow an end user to accurately position the end effector of the arm.

Referring to the drawings more particularly by reference numbers, Figure 1 shows an embodiment of a support arm 10 of the present invention. The support arm 10 includes an arm 12 that is coupled to a table mount 14. The table mount 14 is adapted to be secured to a surgical table (not shown). The support arm 10 further includes an end effector 16 that is coupled to the arm 12. The end effector 16 is adapted to hold a surgical instrument such as a heart stabilizer (not shown). The support arm 10 provide an apparatus that can support a heart stabilizer during a surgical procedure. It is desirable to provide a support arm 10 to hold the heart stabilizer so that a surgical aide does not have to hold the stabilizer

throughout the procedure, particularly a CABG procedure which may require hours to perform.

The arm 12 may include a first linkage 18 that is coupled to the table mount 14 and a second linkage 20 coupled to the first linkage 18. The arm 12 may further have a third linkage 22 coupled to the second linkage 20.

The first linkage 18 may extend through a clearance hole (not shown) in a base 24 of the table mount 16. The table mount 14 may have an arm clamp 26 that can be rotated to engage the first linkage 18 and secure the position of the end effector 16 in a vertical direction. The arm clamp 26 can be rotated in an opposite direction to disengage the clamp 26 and allow an end user to move the first linkage 18 and adjust the height of the end effector 16.

The table mount base 24 may include a jaw section 28 that can clasp onto the rail of an operating table (not shown). The jaw section 28 can be secured to the table rail by a table clamp 30.

The second linkage 20 may be coupled to the first linkage 18 by a first ball joint 32. Likewise, the end effector 16 may be coupled to the third linkage 22 by a

second ball joint 34. The third linkage 22 may be coupled to the second linkage 20 by a pivot joint 36. The ball joints 32 and 34, and pivot joint 36 provide the support arm six degrees of freedom. The position of the arm 12 and end effector 16 can be secured and locked in place by rotating a locking knob 38. The locking knob 38 clamps the pivot joint 36 to prevent relative movement between the third 22 and second 20 linkages. Rotation of the locking knob 38 also moves corresponding wedges (not shown) into the ball joints 32 and 34 to secure and lock the second linkage 20 and the end effector 16, respectively. The arm 12 and table mount 16 can be purchased from KARL STORZ under part number 28172H.

Figure 2 shows an embodiment of the end effector 16. The end effector 16 includes a retractable jaw member 40 that can move relative to a stationary jaw member 42 along an internal threaded shaft 44. Movement of the retractable jaw member 40 may be guided by an internal bearing collar 46 that is attached to the shaft 44 by a pin 48. The retractable jaw member 40 may be biased into a closed position by a spring 50. The deflection and resultant

spring force of the spring 50 may be varied by rotating an adjustment collar 52 that can be moved along the shaft 44.

The jaws 40 and 42 may have channels 54 that accommodate cylindrical shaped instruments such as a heart stabilizer 60. The channels 54 may have two different radiuses to accommodate instruments having different diameters. By way of example, the channels 54 may receive instrument shafts having diameters that range between 2 and 15 millimeters. The jaws 40 and 42 may also have end plates 56 that accommodate rectangular shaped instruments.

As shown in Figure 3, the table mount 14 can be mounted to a table rail 58. A surgical instrument 60 such as a heart stabilizer is typically inserted into a patient to perform a surgical procedure. The position of the end effector 16 is aligned with the surgical instrument 60 by adjusting the arm 12. The surgical instrument 60 is then attached to the end effector 16 by retracting and then releasing the retractable jaw member 40. The arm 12 is locked in place by rotating the locking knob 38. A surgeon can both hold and secure the instrument 60 to the support arm 10. Alternatively, the surgeon can hold the surgical

instrument 60 and another person can couple the instrument 60 to the end effector 16. The support arm 10 will hold the instrument 60 during a surgical procedure without requiring any additional personnel to hold the instrument 60. The surgical instrument 60 can be released by retracting the jaw member 40 and pulling the instrument 60 away from the support arm 10.

While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art.